VOLUME I

OPENING ADDRESS-THE EMPEROR OF JAPAN v

POEM FOR ACID RAIN 2000 vi

PREFACE vii

Organizing committee / Scientific committee viii

International Advisory Board iv

Contents of Volumes I x

Conference Summary Statements 1-16

PLENARY AND KEYNOTE PAPERS

JAMES N. GALLOWAY
Acidification of the World: Natural and Anthropogenic 17-24

PETER BRIMBLECOMBE
Acid Rain 2000±1000 25-30

KENICHI SATAKE
New Eyes for Looking Back to the Past and Thinking of the Future 31-42

M. AMANN
Emission Inventories, Emission Control Options and Control Strategies: an Overview of Recent Developments 43-50

GREGORY R. CARMICHAEL, HIROSHI HAYAMI, GIUSEPPE CALORI, ITSUSHI UNO, SEOG YEON CHO, MAGNUZ ENGARDT, SEUNG -BUM KIM, YOICHI ICHIKAWA, YUKOH IKEDA, HIROMASA UEDA and MARKUS AMANN
Model Intercomparison Study of Long Range Transport and Sulfur Deposition in East Asia (MICS-ASIA) 51-62

DAVID FOWLER, CHRIS FLECHARD, J. NEIL CAPE , ROBERT L. STORETON-WEST and MHAIRI COYLE
Measurements of Ozone Deposition to Vegetation Quantifying the Flux, the Stomatal and Non-Stomatal Components 63-74

M. J. MITCHELL, B. MAYER, S. W. BAILEY, J. W. HORNBECK, C. ALEWELL, C. T. DRISCOLL and G. E. LIKENS
Use of Stable Isotope Ratios for Evaluating Sulfur Sources and Losses at the Hubbard Brook Experimental Forest 75-86

G. G. RADDUM, A. FJELLHEIM and B. L. SKJELKVÅLE
Improvements in Water Quality and Aquatic Ecosystems due to Reduction in Sulphur Deposition in Norway 87-98

KAZUMASA IKUTA, ARIMUNE MUNAKATA, KATSUMI AIDA, MASAFUMI AMANO and SHOJI KITAMURA
Effects of Low pH on Upstream Migratory Behavior in Land-Locked Sockeye Salmon *Oncorhynchus nerka* 99-106

L. D. EMBERSON, M. R. ASHMORE, F. MURRAY, J. C. I. KUYLENSTIERNA, K. E. PERCY, T. IZUTA, Y. ZHENG, H. SHIMIZU, B. H. SHEU, C. P. LIU, M. AGRAWAL, A. WAHID, N. M. ABDEL-LATIF, M. VAN TIENHOVEN, L. I. DE BAUER and M. DOMINGOS
Impacts of Air Pollutants on Vegetation in Developing Countries 107-118

K. R. BULL, B. ACHERMANN, V. BASHKIN, R. CHRAST, G. FENECH, M. FORSIUS, H. -D GREGOR, R. GUARDANS, T. HAUßMANN, F. HAYES, J. -P. HETTELINGH, T. JOHANNESSEN, M. KRZYZANOWSKI, V. KUCERA, B. KVAEVEN, M. LORENZ, L. LUNDIN, G. MILLS, M. POSCH, B. L. SKJELKVÅLE and M. J. ULSTEIN
Coordinated Effects Monitoring and Modelling for Developing and Supporting International Air Pollution Control Agreements 119-130

JOHN GUNN and STEINAR SANDØY
Northern Lakes Recovery Study (NLRS) - Biomonitoring at the Ecosystem Level 131-140

Y. MAEDA, J. MORIOKA, Y. TSUJINO, Y. SATOH, XIAODAN ZHANG, T. MIZOGUCHI and S. HATAKEYAMA
Material Damage Caused by Acidic Air Pollution in East Asia 141-150

SUPAT WANGWONGWATANA
Step-by-Step Approach to Establish Acid Deposition Monitoring Network in East Asia (EANET): Thailand's Experiences 151-162

GUOYING QIN and MEIYUAN HUANG
A Study on Rain Acidification Processes in Ten Cities of China 163-174

M. JOHANSSON, M. ALVETEG, M. AMANN, J. BAK, J. BARTNICKI, M. EKQVIST, M. FORSIUS, L. FROHN, G. GEERNAERT, B. GIMENO, R. GUARDANS, N. KARVOSENOJA, F. MARTÍN, M. POSCH, R. SUUTARI and S. SYRI
Integrated Assessment Modeling of Air Pollution in Four European Countries 175-186

Contents of Volumes

Authors Index

Subject Index

List of organizations sponsored the Conference

VOLUME II

Preface iii

Contents of Volume II v

EMISSIONS AND THEIR CONTROL

DAVID G. STREETS, NANCY Y. TSAI, HAJIME AKIMOTO and KAORU OKA
Trends in Emissions of Acidifying Species in Asia, 1985 - 1997 187-192

Z. KLIMONT, J. COFALA, W. SCHÖPP, M. AMANN, D. G. STREETS, Y. ICHIKAWA and S. FUJITA
Projections of SO_2, NOx, NH_3 and VOC Emissions in East Asia up to 2030 193-198

YUTAKA TONOOKA, AKIYOSHI KANNARI, HARUYUKI HIGASHINO and KENTARO MURANO
NMVOCs and CO Emission Inventory in East Asia 199-204

ALEXEY G. RYABOSHAPKO
Anthropogenic Ammonia Emissions in the Former USSR in 1990 205-210

W. KEVIN HICKS, JOHAN C.I. KUYLENSTIERNA, VIKROM MATHUR, SERGIO MAZZUCCHELLI, VIVIANA BURIJSON, SURENDRA SHRESTHA, MYLVAKANAM IYNGARARASAN, STEPHEN SIMUKANGA and A. MIEKE VAN TIENHOVEN
Development of the Regional Policy Process for Air Pollution in South Asia, Southern Africa and Latin America 211-216

HARRY W. VALLACK, STEVE CINDERBY, JOHAN C.I. KUYLENSTIERNA and CHARLES HEAPS
Emission Inventories for SO_2 and NO_X in Developing Country Regions in 1995 with Projected Emissions for 2025 According to Two Scenarios 217-222

M. AMANN, M. JOHANSSON, A. LÜKEWILLE, W. SCHÖPP, H. APSIMON, R. WARREN, T. GONZALES, L. TARRASON and S. TSYRO
An Integrated Assessment Model for Fine Particulate Matter in Europe 223-228

ANKE LÜKEWILLE, IMRICH BERTOK, MARKUS AMANN, JANUSZ COFALA, FRANTISEK GYARFAS, MATTI JOHANSSON, ZBIGNIEW KLIMONT, ELISABETH PACYNA and JOZEF PACYNA
A Module to Calculate Primary Particulate Matter Emissions and Abatement Measures in Europe 229-234

C. PENG, JITENDRA J. SHAH, TANVI NAGPAL, TODD JOHNSON and JIA LI
Rains-Asia Model Application to China: Policy Implications 235-240

STEPHANIE ROSE BENKOVIC and JOSEPH KRUGER
U.S. Sulfur Dioxide Emissions Trading Program:Results and Further Applications 241-246

SHIDONG GAO, KAZUHIKO SAKAMOTO, DAWEI ZHAO, DONGBAO ZHANG, XUHUI DONG and SHIRO HATAKEYAMA
Studies on Atmospheric Pollution, Acid Rain and Emission Control for Their Precursors in Chongqing, China 247-252

K. SAKAMOTO, Y. TERAUCHI, O. ISHITANI, M. KAMIDE and Q. WANG
Emission Control of SO_2 by Dry Coal-Cleaning and Bio-Briquette Technology 253-258

JIMING HAO, SHUXIAO WANG, BINGJIANG LIU and KEBIN HE
Plotting of Acid Rain and Sulfur Dioxide Pollution Control Zones and Integrated Control Planning in China 259-264

Y. IKEDA, R. YASUDA, H. NAKAMINAMI, M. TANAKA, C. LEE and H. HIGASHINO
A Mixed-Integer Optimization Technique for Developing a Sulfur Emission Control Strategy for China 265-270

D. N. ZHANG, Q. Z. CHEN, Y. X. ZHAO, Y. MAEDA and Y. TSUJINO
Stack Gas Desulfurization by Seawater in Shanghai 271-276

DENNIS Y.C. LEUNG
Development of a Clean Biodiesel Fuel in Hong Kong Using Recycled Oil 277-282

REACTIONS, TRANSPORT AND DIFFUSION

HIROSHI HAYAMI and YOICHI ICHIKAWA
Sensitivity of Long-range Transport of Sulfur Compounds to Vertical Distribution of Sources 283-288

MAGNUZ ENGARDT
Sulphur Simulations for East Asia Using the MATCH Model with Meteorological Data from ECMWF 289-294

TOSHIMASA OHARA, ITSUSHI UNO, SHINJI WAKAMATSU and KENTARO MURANO
Numerical Simulation of the Springtime Trans-Boundary Air Pollution in East Asia 295-300

YOICHI ICHIKAWA, HIROSHI HAYAMI, TAISHI SUGIYAMA, MARKUS AMANN and WOLFGANG SCHÖPP
Forecast of Sulfur Deposition in Japan for Various Energy Supply and Emission Control Scenarios 301-306

SADATAKA SHIBA, YUSHI HIRATA and SHUNSAKU YAGI
Acidification of Growing Cloud Droplet by Rainout of SO_2 (g) 307-312

KEIICHI WATANABE, SADATAKA SHIBA and YUSHI HIRATA
Characteristics of Raindrop Acidification by Co-washout of $SO_2(g)$-$H_2O_2(g)$-$HNO_3(g)$ 313-318

DRIEJANA, D. S. LEE, R. D. KINGDON, D. W. RAPER and I. L. GEE
Modelling Acidic Deposition in the United Kingdom at a Scale of 5km by 5km 319-324

M. UTIYAMA, T. FUKUYAMA, S. YAMAGATA, S. OHTA, K. IZUMI, T. HARIMAYA, Y. FUJIYOSHI, T. YAMADA and M. INAGE
Rate of Sulfur Dioxide Removal Artificial Cloud Experiments Utilizing a Long Vertical Shaft 325-330

K. ACKER, D. MÖLLER, W. WIEPRECHT, R. AUEL, D. KALASS and W. TSCHERWENKA
Nitrous and Nitric Acid Measurements Inside and Outside of Clouds at Mt.Brocken 331-336

TETSUYA ADZUHATA, TOMOKO OKAMURA, JUNKO INOTSUME, RYOEI KIKUCHI, TORU OZEKI, MASAHIRO KAJIKAWA and NOBUAKI OGAWA
Chemical Characterization of Acid Fog and Rain in Northern Japan using Back Trajectory and Oblique Rotational Factor Analysis 337-342

AKIHIKO NAEMURA, AKIO TSUCHIYA and KANEYUKI NAKANE
Climatological and Geographical Characteristics within Inversion Layers in the Presence of High NO_2 Concentration 343-348

YASUHITO IGARASHI, MICHIO AOYAMA, KATSUMI HIROSE, TAKASHI MIYAO and SADAYO YABUKI
Is it Possible to Use ^{90}Sr and ^{137}Cs as Tracers for the Aeolian Dust Transport? 349-354

TAKAHISA MAEDA, MASAYASU HAYASHI, RYOICHI IMASU and ZIFA WANG
A Model Analysis of Transport of Sulfur Oxides in China and Outflow to the Sea 355-360

JAE -CHEOL NAM, DEB J. FISH, ALAN J. THORPE and SOON-UNG PARK
Modelling the Vertical Transport of Pollutants by Fronts 361-366

YONG -SEUNG CHUNG, HAK -SUNG KIM and KIE -HYUN PARK
Acidic Precipitation and Large-Scale Transport of Air Pollutants Observed in Korea 367-372

SHIRO HATAKEYAMA, KENTARO MURANO, FUMIO SAKAMAKI, HITOSHI MUKAI, HIROSHI BANDOW and YUICHI KOMAZAKI
Transport of Atmospheric Pollutants from East Asia 373-378

B. G. KIM, J. Y. AHN, H. R. NOH, C. J. PARK, J. S. HAN and S. U. PARK
Physical and Chemical Properties of a Winter-time Yellow Sand Event in Northeast Asia 379-384

KISEI KINOSHITA, NAOKO IINO, ITSUSHI UNO, ATSUKO MORI, SHIN-ICHIRO IKEBE and JUN-ICHI KOHNO
Satellite Analysis of Volcanic Clouds and Transport of Acidic Substances from Mt. Aso and Mt. Sakurajima 385-390

Z. WANG, T. MAEDA, M. HAYASHI, L. -F. HSIAO and K. -Y. LIU
A Nested Air Quality Prediction Modeling System for Urban and Regional Scales: Application for High-Ozone Episode in Taiwan 391-396

NOBUTAKE NAKATANI, TAKAYUKI MIYAKE, MASAAKI CHIWA, NORICHIKA HASHIMOTO, TAKEMITSU ARAKAKI and HIROSHI SAKUGAWA
Photochemical Formation of OH Radicals in Dew Formed on the Pine Needles at Mt. Gokurakuji 397-402

YASUYUKI ITANO, MUNEHIRO WARASHINA, KAIHEI TAKEDA, HIROSHI BANDOW, YASUAKI MAEDA and MASANOBU TANAKA
Oxidation of Nitrogen Oxide Related to Photoreactive Hydrocarbons in Urban Atmosphere 403-408

WET AND DRY DEPOSITION

MARK A. NILLES and BROOKE E. CONLEY
Changes in the Chemistry of Precipitation in the United States, 1981 - 1998 409-414

SHIN-ICHI FUJITA, AKIRA TAKAHASHI, HIROSHI HAYAMI and TATSUYA SAKURAI
Long-Term Trends in the Chemical Composition of Precipitation over Western Japan 415-420

IZUMI NOGUCHI, TAKUNORI KATOH, SHIGEKATSU SAKAI, RIKI IWATA, MASAYUKI AKIYAMA, HIDEYUKI OHTSUKA, KOUICHI SAKATA, HIROHIDE AGA and YUTAKA MATSUMOTO
Snowcover Components in Northern Japan 421-426

BO -KYOUNG LEE, DONG SOO LEE and MAN -GOO KIM
Rapid Time Variations in Chemical Composition of Precipitation in South Korea 427-432

JAE -CHEOL NAM, SUNG -NAM OH, JAE -CHEON CHOI, JIYOUNG KIM and YOUNGSIN CHUN
Monitoring of Acid Rain over Korean Peninsula 433-438

MAN -GOO KIM , MI-HEE KANG, KI-JUN PARK , BO-KYUNG LEE and DONG-SOO LEE
Evaluation of precipitation Composition at an Urban and a Rural Area for the Central Korean Peninsula 439-444

C. J. PARK, H. R. NOH, B. G. KIM, S. Y. KIM, I. U. JUNG, C. R. CHO and J. S. HAN
Evaluation of Acid Deposition in Korea 445-450

R. BALASUBRAMANIAN, T. VICTOR and N. CHUN
Chemical and Statistical Analysis of Precipitation in Singapore 451-456

Z. C. ZHONG, T. VICTOR and R. BALASUBRAMANIAN
Measurement of Major Organic Acids in Rainwater in Southeast Asia during Burning and Non-burning Periods 457-462

K. S. PATEL, A. SHUKLA, A. N. TRIPATHI and P. HOFFMANN
Heavy Metal Concentrations of Precipitation in East Madhya Pradesh of India 463-468

L. GRANAT, S. N. DAS, R. S. THARKUR and H. RODHE
Atmospheric Deposition in a Rural Area in India - Net and Potential Acidity 469-474

A. G. PILLAI, MEDHA S. NAIK, G. A. MOMIN, P. S. P. RAO, P. D. SAFAI , K. ALI, HENNING RODHE and LENNART GRANAT
Studies of Wet Deposition and Dustfall at Pune, India 475-480

MADHOOLIKA AGRAWAL and RAJ KUMAR SINGH
Effect of Industrial Emission on Atmospheric Wet Deposition 481-486

BOEUN HAN, JAEHEE KIM and SEOG YEON CHO
A Numerical Simulation of Acid Deposition in East Asia 487-492

SINYA SETO, MANABU SATO and HIROSHI HARA
Source Identification of Rural Precipitation Chemistry in Japan 493-498

YOUNG-HEE LEE and SOON-UNG PARK
Wet Deposition of Pollutants and Precipitation Patterns Classified by Cluster Analysis of 850 hPa Geopotential Height in South Korea 499-504

STANISLAW MALEK
Quantitative and Qualitative Changes of Precipitation Input to the Ojców National Park (South Poland) during 1997-1999 505-510

JOSE A MORALES, LIGBEL SANCHEZ, HARVI VELASQUEZ, BEATRIZ DE BORREGO, MARLENE DE NAVA, DENIS PORTILLO, YULIXIS CANO, ANGEL MORILLO, ANA ALBORNOZ and ELSA SOCORRO
Nutrient Loading by Precipitation in the Maracaibo Lake Basin, Venezuela 511-516

D. SOPAUSKIENE, D. JASINEVICIENE and S. STAPCINSKAITE
The Effect of Changes in European Anthropogenic Emissions on the Concentrations of Sulphur and Nitrogen Components in Air and Precipitation in Lithuania 517-522

SERGEY V. KAKAREKA
Deposition and Emission Fluxes of Acidifying Compounds on the Territory of Belarus 523-528

TUIJA RUOHO-AIROLA and TIMO SALMI
Episodicity of Sulphate Deposition in Finland 529-534

SUSUMU TOHNO, TAKUYA TAKANO and MIKIO KASAHARA
Simultaneous Determination of Gas and Particle Dry Deposition onto Conditioned Surrogate Surfaces 535-540

A. SORIMACHI, M. SAKAI, O. ISHITANI, M. NISHIKAWA and K. SAKAMOTO
Study on Dry Deposition of SO_2-NOx onto Loess 541-546

M. UTIYAMA, T. FUKUYAMA, K. IZUMI, K. SAKAMOTO, K. SEKIGUCHI, W. KIM, A. KOYAMA, M. AOKI and H. HARA
Fine Particle Dry Deposition onto a Cropland –a Trial to Estimate Deposition Velocity 547-552

KAZUHIDE MATSUDA, NORIO FUKUZAKI and MASAHITO MAEDA
A Case Study on Estimation of Dry Deposition of Sulfur and Nitrogen Compounds by Inferential Method 553-558

AKIRA TAKAHASHI, KAZUO SATO, TAKASHI WAKAMATSU and SHIN-ICHI FUJITA
Atmospheric Deposition of Acidifying Components to a Japanese Cedar Forest 559-564

MAN-GOO KIM, YOUNG-MIN HONG, MI-HEE KANG, DONG-SOO LEE and BO-KYOUNG LEE
Estimation of Dry Deposition by using a Filter Pack Method at Chunchon, Korea 565-570

MARGARIDA C. MARQUES, GODE GRAVENHORST and ANDREAS IBROM
Input of Atmospheric Particles into Forest Stands by Dry Deposition 571-576

L. D. EMBERSON, M. R. ASHMORE, D. SIMPSON, J.-P. TUOVINEN and H. M. CAMBRIDGE
Modelling and Mapping Ozone Deposition in Europe 577-582

JONNIFER R. SINOGAYA and HIROSHI SAKUGAWA
Simulation of Dry Deposition Rates of Acidic Pollutants -an Assessment of Deposition Pathways in Hiroshima, Japan 583-588

SERGEY A. GROMOV, ALEXEY G. RYABOSHAPKO and SERGEY G. PARAMONOV
Dry Deposition of Atmospheric Sulphur and Nitrogen in Russia and the Former USSR 589-594

HARUKO SUZUKI, HIROSHI HARA, MASATOSHI AOKI, KENICHI TAKANO, KATUYUKI IZUMI, TSUTOMU FUKUYAMA, MASAHIRO UTIYAMA and TOSHIICHI OKITA
Some Measurement Results on Sulfate Aerosol Concentration in and above a Pine Canopy 595-600

TOMIKI KOBAYASHI, YOSHIHIRO NAKAGAWA, MOTONORI TAMAKI, TAKATOSHI HIRAKI and MASAHIDE AIKAWA
Cloud Water Deposition to Forest Canopies of *Cryptomeria Japonica* at Mt. Rokko, Kobe,Japan 601-606

M. IGAWA, K. MATSUMURA and H. OKOCHI
Fog Water Chemistry at Mt. Oyama and its Dominant Factors 607-612

MASAKI TAKEUCHI, HIROSHI OKOCHI and MANABU IGAWA
Dominant Factors of Major and Minor Components and Formation of Hydroxyalkanesulfonate in Urban Dew-Water 613-618

J. NEIL CAPE, ALASTAIR DUNSTER, ALAN CROSSLEY, LUCY J. SHEPPARD and FRANK J. HARVEY
Throughfall Chemistry in a Sitka Spruce Plantation in Response to Six Different Simulated Polluted Mist Treatments 619-624

SHIN-ICHI WAKIDA, MASATAKA YAMANE, SAHORI TAKEDA, ZYUN SIROMA, YUTAKA TSUJIMURA and JIANHUA LIU
Studies on pH and Nitrate Checkers Made of Semiconductor Devices for Acid Rain Monitoring 625-630

BIOGEOCHEMICAL CYCLES

S. LÖFGREN, L. BRINGMARK, M. AASTRUP, H. HULTBERG, K. KINDBOM and H. KVARNÄS
Sulphur Balances and Dynamics in Three Forested Catchments in Sweden..... 631-636

PÅL ANDERSSON, DAN BERGGREN and LARS JOHNSSON
30 Years of N Fertilisation in a Forest Ecosystem -the Fate of Added N and Effects on N Fluxes 637-642

JI -HYUNG PARK and EGBERT MATZNER
Carbon Control on Nitrogen Dynamics in the Forest Floor of an N-enriched Deciduous Forest Ecosystem 643-648

NOBUHITO OHTE, MYRON J. MITCHELL, HIDEAKI SHIBATA, NAOKO TOKUCHI, HIROTO TODA and GORO IWATSUBO
Comparative Evaluation on Nitrogen Saturation of Forest Catchments in Japan and Northeastern United States 649-654

MUNEOKI YOH, EIICHI KONOHIRA and KAZUYUKI YAGI
Regional Distribution of Natural Stream Nitrate in Central Japan 655-660

MUNEOKI YOH
Soil C/N Ratio as Affected by Climate: an Ecological Factor of Forest NO_3^- Leaching 661-666

EIICHI KONOHIRA, MUNEOKI YOH, JUMPEI KUBOTA, KAZUYUKI YAGI and HIROKO AKIYAMA
Effects of Riparian Denitrification on Stream Nitrate -Evidence from Isotope Analysis and Extreme Nitrate Leaching during Rainfall- 667-672

N. OURA, J. SHINDO, T. FUMOTO, H. TODA and H. KAWASHIMA
Effects of Nitrogen Deposition on Nitrous Oxide Emissions from the Forest Floor 673-678

SATORU HOBARA, TAKASHI OSONO, KEISUKE KOBA, NAOKO TOKUCHI, SATOMI FUJIWARA and KAYOKO KAMEDA
Forest Floor Quality and N Transformations in a Temperate Forest Affected by Avian-Derived N Deposition 679-684

H. SHIBATA, F. SATOH, K. SASA, M. OZAWA, N. USUI, O. NAGATA, Y. HAYAKAWA and R. HATANO
Importance of Internal Proton Production for the Proton Budget in Japanese Forested Ecosystems 685-690

O. NAGATA, A. MANAGI, Y. HAYAKAWA, R. HATANO, H. SHIBATA and F. SATOH
Seasonal Dynamics of Biogeochemical Proton and Base Cation Fluxes in a White Birch Forest in Hokkaido, Japan 691-696

MACHIKO KIRIKAE, RYUSUKE HATANO, HIDEAKI SHIBATA and YUMIKO TANAKA
Analysis of Proton Generation and Consumption of Forest Surface Soils in Hokkaido, Northern Japan 697-702

M. OZAWA, H. SHIBATA, F. SATOH and K. SASA
Annual Element Budget of Soil in Snow -Dominated Forested Ecosystem..... 703-708

ASAMI NAKANISHI, HIDEAKI SHIBATA, YOJI INOKURA, TOSHIO NAKAO, HIROTO TODA, FUYUKI SATOH and KAICHIRO SASA
Chemical Characteristics in Stemflow of Japanese Cedar in Japan 709-714

YASUNORI NAKAGAWA, LI CHANGHUA and GORO IWATSUBO
Element Budgets in a Forested Watershed in Southern China:Estimation of a Proton Budget 715-720

TAKASHI WAKAMATSU, KAZUO SATO, AKIRA TAKAHASHI and HIDEAKI SHIBATA
Proton Budget for a Japanese Cedar Forest Ecosystem 721-726

M. TAKAHASHI, T. SAKATA and K. ISHIZUKA
Chemical Characteristics and Acid Buffering Capacity of Surface Soils in Japanese Forests 727-732

TAKANORI NAKANO, YORIKO YOKOO, RYO ANMA and JUNKO SHINDO
Ca Depletion in the Soil Column on a Granite Substrate on the Island of Yakushima, a World Natural Heritage Site 733-738

SEO -RYONG JEON and TAKANORI NAKANO
Geochemical Comparison of Stream Water, Rain Water, and Watershed Geology in Central Korea 739-744

R. D. VOGT, H. M. SEIP, H. OREFELLEN, G. SKOTTE, C. IRGENS and J. TYSZKA
Aluminium Mobility at an Acid Sensitive Site with High S-Deposition 745-750

T. OHTANI, N. UEMATSU, S. YASHIMA and M. FUKAMI
Effect of Anions in Simulated Precipitation on the Uptake of Heavy Metals and Aluminum by *Brassica Rapa* L. Grown in Heavy- Metal- Contaminated Sandy Soil 751-756

MAYUMI KOBAYASHI, AKIRA SAWADA, YUKINORI TANI, MITSUYUKI SOMA, ATSUSHI TANAKA, TAKUYA HONMA, HARUHIKO SEYAMA and BENNY K.G. THENG
Acid Dissolution of Olivines, Feldspars and Dunite 757-762

YORIKO YOKOO, TAKANORI NAKANO, MASATAKA NISHIKAWA and HAO QUAN
The Importance of Sr Isotopic Compositions as an Indicator of Acid-Soluble Minerals in Arid Soils in China 763-768

TAKANORI NAKANO, SEO -RYONG JEON, JUNKO SHINDO, TAMON FUMOTO, NAOKI OKADA and JUN SHIMADA
Sr Isotopic Signature in Plant-derived Ca in Rain 769-774

EFFECTS ON AQUATIC ECOSYSTEMS

BERIT KVAEVEN, MERETE J. ULSTEIN, BRIT L. SKJELKVÅLE, GUNNAR G. RADDUM and H. HOVIND
ICP Waters - an International Programme for Surface Water Monitoring 775-780

JOHN L. STODDARD, TOR S. TRAAEN and BRIT LISA SKJELKVÅLE
Assessment of Nitrogen Leaching at ICP-Waters Sites (Europe and North America) 781-786

BRIT LISA SKJELKVÅLE, JOHN L. STODDARD and T. ANDERSEN
Trends in Surface Water Acidification in Europe and North America (1989-1998) 787-792

WENDEL(BILL) KELLER, PETER DILLON, JOCELYNE HENEBERRY, MICHAEL MALETTE and JOHN GUNN
Sulphate in Sudbury, Ontario, Canada, Lakes: Recent Trends and Status 793-798

S. J. KÖHLER, S. LÖFGREN, A. WILANDER and K. BISHOP
Validating a Simple Equation to Predict and Analyze Organic Anion Charge in Swedish Low Ionic Strength Surface Waters 799-804

YUKIHO IKEDA and TAKESHI HAMADA
Trends of Major Inorganic Species at the Small Watershed Ecosystem in Northern Tama Hills, the Western Tokyo Metropolitan Area, Japan 805-810

H. AGA, I. NOGUCHI and K. SAKATA
Aquatic Chemistry of a Reservoir during the Thaw Season 811-816

ØYVIND ALMSKAR SCHNELL
The Chironomid (Diptera) Subfossil Record of Lille Hovvatn (Norway), with a Comparison with a Similar Study in Adjacent Store Hovvatn 817-824

G. G. RADDUM and B. L. SKJELKVÅLE
Critical Limit of Acidifying Compounds to Invertebrates in Different Regions of Europe 825-830

HEIKKI ERKINARO, JAAKKO ERKINARO, MARTTI RASK and EERO NIEMELÄ
Status of Zoobenthos and Fish Populations in Subarctic Rivers of the Northernmost Finland: Possible Effects of Acid Emissions from Russian Kola Peninsula 831-836

JAN HERRMANN
Aluminium is Harmful to Benthic Invertebrates in Acidified Waters, but at What Threshold(s)? 837-842

A. M. PUSTE and D. K. DAS
Impact of Air Pollutant Emissions on the Ecosystems in the Vicinity of Industrial Areas of Indian Sub -Tropics 843-848

GARETH J.P. THORNTON, LEE S. OLIVER and A. JOSHUA WEST
Acid Sensitivity of Three Large Nepalese Catchments: Case Study of Bhote Kosi, Everest and Langtang 849-854

SHANKAR G. AGGARWAL, CHANDRA K. CHANDRAWANSHI, RAJ M. PATEL, SMITA AGARWAL, ANAND KAMAVISDAR and GIRDHAR L. MUNDHARA
Acidification of Surface Water in Central India 855-862

STEFAN LÖFGREN
The Chemical Effects of Deicing Salt on Soil and Stream Water of Five Catchments in Southeast Sweden 863-868

T. NAKANO, M. OKUMURA, M. YAMANAKA and K. SATAKE
Geochemical Characteristics of Acidic Stream Water on Yakushima Island, a World Natural Heritage Site 869-874

SHOJI KITAMURA and KAZUMASA IKUTA
Effects of Acidification on Salmonid Spawning Behavior 875-880

J. A. MAGEE, T. A. HAINES, J. F. KOCIK, K. F. BELAND and S. D. MCCORMICK
Effects of Acidity and Aluminum on the Physiology and Migratory Behavior of Atlantic Salmon Smolts in Maine, USA 881-886

KOGI OGAWA, FUMINARI ITO, MASAKI NAGAE, TEIICHI NISHIMURA, MOTOYOSHI YAMAGUCHI and ATSUSHI ISHIMATSU
Effects of Acid Stress on Reproductive Functions in Immature Carp, *Cyprinus Carpio* 887-892

MASAKI NAGAE, KOUGI OGAWA, AKIRA KAWAHARA, MOTOYOSHI YAMAGUCHI, TEIICHI NISHIMURA and FUMINARI ITO
Effect of Acidification Stress on Endocrine and Immune Functions in Carp, *Cyprinus Carpio* 893-898

B. O. ROSSELAND, F. KROGLUND, M. STAURNES, K. HINDAR and A. KVELLESTAD
Tolerance to Acid Water among Strains and Life Stages of Atlantic Salmon (*Salmo Salar L.*) 899-904

FRODE KROGLUND, HANS C. TEIEN, BJØRN O. ROSSELAND and BRIT SALBU
Time and pH-Dependent Detoxification of Aluminum in Mixing Zones between Acid and Non-Acid Rivers 905-910

FRODE KROGLUND, HANS C. TEIEN, BJØRN O. ROSSELAND, BRIT SALBU and ESTHER C.H.E.T LUCASSEN
Water Quality Dependent Recovery from Aluminum Stress in Atlantic Salmon Smolt 911-916

KIYOSHI ISHIKAWA, HIROSHI HORIMOTO and NORIAKI HACHINOHE
Characteristics of Monomeric Al Concentration in an Acidified River 917-922

VOLUME III

Preface iii

Contents of Volume III v

EFFECTS ON TERRESTRIAL ECOSYSTEM

EUGENIJA KUPČINSKIENĖ
Annual Variations of Needle Surface Characteristics of *Pinus Sylvestris* Growing Near the Emission Source 923-928

GALINA N. KOPTSIK, SERGUEI V. KOPTSIK and DAN AAMLID
Pine Needle Chemistry Near a Large Point SO_2 Source in Northern Fennoscandia 929-934

JESADA. LUANGJAME, BOONCHOOB BOONTAWEE and NIGORN. KLIANGPIBOOL
Determination of Deposition and Leaves in Teak Plantations in Thailand 935-940

T. TAKAMATSU, H. SASE, J. TAKADA and R. MATSUSHITA
Annual Changes in Some Physiological Properties of *Cryptomeria Japonica* Leaves from Kanto, Japan 941-946

ELINA J. OKSANEN
Increasing Tropospheric Ozone Level Reduced Birch (*Betula Pendula*) Dry Mass within a Five Years Period 947-952

LUCY J. SHEPPARD, ALAN CROSSLEY, JUDITH PARRINGTON, FRANCIS J HARVEY and J. NEIL CAPE
Effects of Simulated Acid Mist on a Sitka Spruce Forest Approaching Canopy Closure: Significance of Acidified Versus Non-Acidified Nitrogen Inputs 953-958

HIDEYUKI MATSUMURA
Impacts of Ambient Ozone and/or Acid Mist on the Growth of 14 Tree Species: an Open-Top Chamber Study Conducted in Japan 959-964

TETSUSHI YONEKURA, YUKIKO DOKIYA, MOTOHIRO FUKAMI and TAKESHI IZUTA
Effects of Ozone and/or Soil Water Stress on Growth and Photosynthesis of *Fagus crenata* Seedlings 965-970

TATSURO NAKAJI and TAKESHI IZUTA
Effects of Ozone and/or Excess Soil Nitrogen on Growth, Needle Gas Exchange Rates and Rubisco Contents of *Pinus densiflora* Seedlings 971-976

Y. KOHNO, R. MATSUKI, S. NOMURA, K. MITSUNARI and M. NAKAO
Neutralization of Acid Droplets on Plant Leaf Surfaces 977-982

JAKUB HRUSKA, PAVEL CUDLÍN and PAVEL KRÁM
Relationship between Norway Spruce Status and Soil Water Base Cations/ Aluminum Ratios in the Czech Republic 983-988

JAN MULDER, HELENE A. DE WIT, HELENA W.J. BOONEN and LARS R. BAKKEN
Increased Levels of Aluminium in Forest Soils: Effects on the Stores of Soil Organic Carbon 989-994

HELENE A. DE WIT, JAN MULDER, PER H. NYGAARD and DAN AAMLID
Testing the Aluminium Toxicity Hypothesis: a Field Manipulation Experiment in Mature Spruce Forest in Norway 995-1000

KAZUO SATO and TAKASHI WAKAMATSU
Soil Solution Chemistry in Forests with Granite Bedrock in Japan 1001-1006

TAKESHI IZUTA, TAEKO YAMAOKA, TATSURO NAKAJI, TETSUSHI YONEKURA, MASAAKI YOKOYAMA, HIDEYUKI MATSUMURA, SACHIE ISHIDA, KENICHI YAZAKI, RYO FUNADA and TAKAYOSHI KOIKE
Growth, Net Photosynthetic Rate, Nutrient Status and Secondary Xylem Anatomical Characteristics of *Fagus crenata* Seedlings Grown in Brown Forest Soil Acidified with H_2SO_4 Solution 1007-1012

RIE TOMIOKA and CHISATO TAKENAKA
Differential Ability of the Root to Change Rhizosphere pH between *Chamaecyparis Obtusa Sieb.* (Hinoki) and *Quercus Serrata* Thumb.(Konara) under Aluminium Stress 1013-1018

MASAHIKO OHNO
Sensitivity of a Japanese Earthworm (*Allolobophora japonica*) to Soil Acidity 1019-1024

SERGUEI V. KOPTSIK, NATALIYA BEREZINA and S. LIVANTSOVA
Effects of Natural Soil Acidification on Biodiversity in Boreal Forest Ecosystems 1025-1030

LARS LUNDIN, MATS AASTRUP, LAGE BRINGMARK, SVEN BRÅKENHIELM, HANS HULTBERG, KJELL JOHANSSON, KARIN KINDBOM, HANS KVARNÄS and STEFAN LÖFGREN
Impacts from Deposition on Swedish Forest Ecosystems Identified by Integrated Monitoring 1031-1036

CAROLE E.R. PITCAIRN, IAN D. LEITH, DAVID FOWLER, KEN J. HARGREAVES, MASOUD MOGHADDAM, VALERIE H. KENNEDY and LENNART GRANAT
Foliar Nitrogen as an Indicator of Nitrogen Deposition and Critical Loads Exceedance on a European Scale 1037-1042

IAN D. LEITH, LUCY J. SHEPPARD, CAROLE E.R. PITCAIRN , J. NEIL CAPE, PAUL W. HILL, VALERIE H. KENNEDY, Y. SIM TANG, RON I. SMITH and DAVID FOWLER
Comparison of the Effects of Wet N Deposition(NH_4Cl) and Dry N Deposition (NH_3) on UK Moorland Species 1043-1048

JOHAN BERGHOLM and HOOSHANG MAJDI
Accumulation of Nutrients in above and below Ground Biomass in Response to Ammonium Sulphate Addition in a Norway Spruce Stand in Southwest Sweden 1049-1054

E. P. FARRELL, J. AHERNE, G. M. BOYLE and N. NUNAN
Long-Term Monitoring of Atmospheric Deposition and the Implications of Ionic Inputs for the Sustainability of a Coniferous Forest Ecosystem 1055-1060

B. K. SITAULA, J. I. B. SITAULA, Å. AAKRA and L. R. BAKKEN
Nitrification and Methane Oxidation in Forest Soil: Acid Deposition, Nitrogen Input and Plant Effects 1061-1066

J. R. HALL, B. REYNOLDS, T. SPARKS, A. COLGAN, I. THORNTON and S. P. MCGRATH
The Relationship between Topsoil and Stream Sediment Heavy Metal Concentrations and Acidification 1067-1072

D. TANG, E. LYDERSEN, H. M. SEIP, V. ANGELL, O. EILERTSEN, T. LARSSEN, X. LIU, G. KONG, J. MULDER, A. SEMB, S. SOLBERG, K. TORSETH, R. D. VOGT, J. XIAO and D. ZHAO
Integrated Monitoring Program on Acidification of Chinese Terrestrial Systems (IMPACTS) - a Chinese- Norwegian Cooperation Project 1073-1078

Y. G. XU, G. Y. ZHOU, Z. M. WU, T. S. LUO and Z. C. HE
Chemical Composition of Precipitation,Throughfall and Soil Solutions at Two Forested Sites in Guangzhou, South China 1079-1084

YASUMI YAGASAKI, TAKASHI CHISHIMA, MASANORI OKAZAKI, DU-SIK JEON, JEONG-HWAN YOO and YOUNG -KULL KIM
Acidification of Red Pine Forest Soil due to Acidic Deposition In Chunchon, Korea 1085-1090

HIROSHI OKOCHI and MANABU IGAWA
Elevational Patterns of Acid Deposition into a Forest and Nitrogen Saturation on Mt. Oyama, Japan. 1091-1096

T. KAWAKAMI, H. HONOKI and H. YASUDA
Acidification of a Small Stream on Kureha Hill Caused by Nitrate Leached from a Forested Watershed 1097-1102

M. BABA, Y. SUZUKI, H. SASAKI, K. MATANO, T. SUGIURA and H. KOBAYASHI
Nitrogen Retention in Japanese Cedar Stands in Northern Honshu, with High Nitrogen Deposition 1103-1108

K. MATANO, M. BABA, A. SHIBUYA, Y. SUZUKI, T. SUGIURA and H. KOBAYASHI
Soil Solution Chemistry in Japanese Cedar Stands in Northern Honshu, with High Nitrogen Deposition 1109-1114

TSUYOSHI YAMADA, SHUICHIRO YOSHINAGA, KAZUHITO MORISADA and KEIZO HIRAI
Sulfate and Nitrate Loads on a Forest Ecosystem in Kochi in Southwest of Japan 1115-1120

M. CRISTINA FORTI, ADILSON CARVALHO, ADOLPHO J. MELFI and CELIA R. MONTES
Deposition Patterns of SO_4^{2-}, NO_3^- and H^+ in the Brazilian Territory 1121-1126

SANJAY KUMAR, R. DATTA, S. SINHA, T. KOJIMA, S. KATOH and M. MOHAN
Carbon Stock, Afforestation and Acidic Deposition: an Analysis of Inter-relation with Reference to Arid Areas 1127-1132

MODELS FOR EVALUATING ECOLOGICATL EFFECTS

J.-P. HETTELINGH, M. POSCH and P.A.M. DE SMET
Multi-Effect Critical Loads Used in Multi-Pollutant Reduction Agreements in Europe 1133-1138

M. POSCH, J.-P. HETTELINGH and P.A.M. DE SMET
Characterization of Critical Load Exceedances in Europe 1139-1144

SOON-UNG PARK and YOUNG-HEE LEE
Estimation of the Maximum Critical Load for Sulfur in South Korea 1145-1150

PETRA MAYERHOFER, JOSEPH ALCAMO, MAXIMILIAN POSCH and JELLE G. VAN MINNEN
Regional Air Pollution and Climate Change in Europe: an Integrated Assessment (AIR-CLIM) 1151-1156

JIMING HAO, XUEMEI YE, LEI DUAN and ZHONGPING ZHOU
Calculating Critical Loads of Sulfur Deposition for 100 Surface Waters in China Using the Magic Model 1157-1162

C. J. CURTIS, R. HARRIMAN, M. HUGHES and M. KERNAN
Effects of Site Selection Strategy on Freshwater Critical Load Exceedances in Wales 1163-1168

M. KERNAN, J. HALL, J. ULLYET and T. ALLOTT
Variation in Freshwater Critical Loads Across Two Upland Catchments in the UK: Implications for Catchment Scale Management 1169-1174

JOHAN C.I. KUYLENSTIERNA, W. KEVIN HICKS, STEVE CINDERBY, HARRY W. VALLACK and MAGNUZ ENGARDT
Variability in Mapping Acidification Risk Scenarios for Terrestrial Ecosystems in Asian Countries 1175-1180

LEO SAARE , REET TALKOP and OTT ROOTS
Air Pollution Effects on Terrestrial Ecosystems in Estonia..... 1181-1186

FULU TAO and ZONGWEI FENG
Critical Loads of Acid Deposition for Ecosystems in South China -- Derived by a New Method 1187-1192

MIKHAIL SEMENOV, VLANDIMIR BASHKIN and HARALD SVERDRUP
Critical Loads of Acidity for Forest Ecosystems of North Asia 1193-1198

LEI DUAN, SHAODONG XIE, ZHONGPING ZHOU, XUEMEI YE and JIMING HAO
Calculation and Mapping of Critical Loads for S, N and Acidity in China..... 1199-1204

JUNLING AN, LING ZHOU, MEIYUAN HUANG, HU LI, TSUNEHIKO OTOSHI and KAZUHIDE MATSUDA
A Literature Review of Uncertainties in Studies of Critical Loads for Acidic Deposition 1205-1210

KENTARO HAYASHI and MASANORI OKAZAKI
Acid Deposition and Critical Load Map of Tokyo 1211-1216

DANIEL KURZ, BEAT RIHM, MATTIAS ALVETEG and HARALD SVERDRUP
Steady-State and Dynamic Assessment of Forest Soil Acidification in Switzerland 1217-1222

BEAT RIHM and DANIEL KURZ
Deposition and Critical Loads of Nitrogen in Switzerland 1223-1228

K. R. BULL, J. R. HALL, J. COOPER, S. E. METCALFE, D. MORTON, J. ULLYETT, T. L. WARR and J. D, WHYATT
Assessing Potential Impacts on Biodiversity Using Critical Loads..... 1229-1234

J. M. ULLYETT, J. R. HALL, M. HORNUNG and M. KERNAN
Mapping the Potential Sensitivity of Surface Waters to Acidification Using Measured Freshwater Critical Loads as an Indicator of Acid Sensitive Areas 1235-1240

GARETH J.P THORNTON
Calculating Weathering Rates of Stream Catchments in the English Lake District Using Critical Element Ratios, Mass-balance Budgets and the Magic Model 1241-1246

TAMON FUMOTO, JUNKO SHINDO, NORIKO OURA and HARALD SVERDRUP
Adapting the Profile Model to Calculate the Critical Loads for East Asian Soils by Including Volcanic Glass Weathering and Alternative Aluminum Solubility System 1247-1252

HIDESHI IKEDA and YOICHI MIYANAGA
Hydrogeochemical Conditions Affecting Acidification of Stream Water in Mountainous Watersheds..... 1253-1258

J. SHINDO, T. FUMOTO, N. OURA, T. NAKANO and T. TAKAMATSU
Estimation of Mineral Weathering Rates under Field Conditions Based on Base Cation Budget and Strontium Isotope Ratios 1259-1264

J. MILINDALEKHA, V. N. BASHKIN, and S. TOWPRAYOON
Calculation and Mapping of Sulfur Critical Loads for Terrestrial Ecosystems of Thailand.....1265-1270

CHRISTINE ALEWELL
Predicting Reversibility of Acidification: The European Sulfur Story 1271-1276

SERGUEI V. KOPTSIK and GALINA N. KOPTSIK
Effects of Acid Deposition on Forest Soils in Northernmost Russia: Modelled and Field Data 1277-1282

HELEN J. FOSTER, MATTHEW J. LEES, HOWARD S. WHEATER, COLIN NEAL and BRIAN REYNOLDS
Dynamic Modelling of Spatially Variable Catchment Hydrochemistry for Critical Loads Assessment 1283-1288

WOJCIECH MILL
Integrated Modelling of Acidification Effects to Forest Ecosystems -Model Sonox 1289-1294

HU LI, AKIKAZU KAGA and KATSUHITO YAMAGUCHI
Prediction of Soil Acidification Using a Dynamic Model at a Bamboo Forest in Osaka Prefecture 1295-1300

PAVEL KRÁM, HJALMAR LAUDON, KEVIN BISHOP, LARS RAPP and JAKUB HRUSKA
Magic Modeling of Long-Term Lake Water and Soil Chemistry at Abborrträsket, Northern Sweden 1301-1306

ECOSYSTEM RECOVERY

D. T. MONTEITH, C. D. EVANS and S. PATRICK
Monitoring Acid Waters in the UK: 1988-1998 Trends 1307-1312

BJØRN WALSENG and LEIF R. KARLSEN
Planktonic and Littoral Microcrustaceans as Indices of Recovery in Limed Lakes in SE Norway 1313-1318

BJØRN WALSENG and ANN KRISTIN L. SCHARTAU
Crustacean Communities in Canada and Norway: Comparison of Species along a pH Gradient 1319-1324

ANN KRISTIN L. SCHARTAU, BJØRN WALSENG and ED SNUCINS
Correlation between Microcrustaceans and Environmental Variables along an Acidification Gradient in Sudbury, Canada 1325-1330

BJØRN WALSENG, ROY M. LANGÅKER, TOR E. BRANDRUD, PÅL BRETTUM, ARNE FJELLHEIM, TRYGVE HESTHAGEN, ØYVIND KASTE, BJØRN M. LARSEN and ELI-A. LINDSTRØM
The River Bjerkreim in SW Norway -Successful Chemical and Biological Recovery after Liming 1331-1336

A. LYCHE-SOLHEIM, Ø. KASTE and E. DONALI
Can Phosphate Help Acidified Lakes to Recover? 1337-1342

S. SANDØY and R. M. LANGÅKER
Atlantic Salmon and Acidification in Southern Norway: A Disaster in the 20 TH Century, but a Hope for the Future? 1343-1348

FRODE KROGLUND, ØYVIND KASTE, BJØRN O. ROSSELAND and TRYGVE POPPE
The Return of the Salmon 1349-1354

TRYGVE HESTHAGEN, TORBJØRN FORSETH, RANDI SAKSGÅRD, HANS M. BERGER and BJØRN M. LARSEN
Recovery of Young Brown Trout in Some Acidified Streams in Southwestern and Western Norway 1355-1360

TRYGVE HESTHAGEN, HANS M. BERGER, ANN KRISTIN LIEN SCHARTAU, TERJE NØST, RANDI SAKSGÅRD and LEIDULF FLØYSTAD
Low Success Rate in Re-Establishing European Perch in Some Highly Acidified Lakes in Southernmost Norway 1361-1366

M. RASK, H. PÖYSÄ, P. NUMMI and C. KARPPINEN
Recovery of the Perch (*Perca Fluviatilis*) in an Acidified Lake and Subsequent Responses in Macroinvertebrates and the Goldeneye (*Bucephala Clangula*) 1367-1372

K. NYBERG, J. VUORENMAA, M. RASK, J. MANNIO and J. RAITANIEMI
Patterns in Water Quality and Fish Status of Some Acidified Lakes in Southern Finland during a Decade: Recovery Proceeding 1373-1378

ARNE FJELLHEIM and GUNNAR G. RADDUM
Acidification and Liming of River Vikedal, Western Norway. A 20 Year Study of Responses in the Benthic Invertebrate Fauna 1379-1384

GODTFRED A. HALVORSEN, JOCELYNE H. HENEBERRY and ED SNUCINS
Sublittoral Chironomids as Indicators of Acidity (Diptera: Chironomidae) 1385-1390

ARNE FJELLHEIM, ÅSMUND TYSSE and VILHELM BJERKNES
Reappearance of Highly Acid-Sensitive Invertebrates after Liming of an Alpine Lake Ecosystem..... 1391-1396

ALUN S. GEE
A Strategic Appraisal of Options to Ameliorate Regional Acidification 1397-1402

ATLE HINDAR, MAXIMILIAN POSCH and ARNE HENRIKSEN
Effects of In-Lake Retention of Nitrogen on Critical Load Calculations 1403-1408

VILHELM BJERKNES and TORULV TJOMSLAND
Flow and pH Modelling to Study the Effects of Liming in Regulated, Acid Salmon Rivers 1409-1414

K. BISHOP, H. LAUDON, J. HRUSKA, P. KRAM, S. KÖHLER and S. LÖFGREN
Does Acidification Policy Follow Research in Northern Sweden? The Case of Natural Acidity during the 1990's 1415-1420

A. WILANDER
Effects of Reduced S Deposition on Large-Scale Transport of Sulphur in Swedish Rivers..... 1421-1426

JAAKKO MANNIO
Recovery Pattern from Acidification of Headwater Lakes in Finland..... 1427-1432

BRIT LISA SKJELKVÅLE, KJETIL TØRSETH, WENCHE AAS and TOM ANDERSEN
Decrease in Acid Deposition - Recovery in Norwegian Waters 1433-1438

JOHN GUNN, ROD SEIN, BILL KELLER and PETER BECKETT
Liming of Acid and Metal Contaminated Catchments for the Improvement of Drainage Water Quality 1439-1444

R. D. VOGT, H. M. SEIP, H. OREFELLEN, G. SKOTTE, C. IRGENS and J. TYSZKA
Trends in Soil Water Composition at a Heavily Polluted Site - Effects of Decreased S-Deposition and Variations in Precipitation..... 1445-1450

KAZUHIKO SAKAMOTO, YUGO ISOBE, XUHUI DONG and SHIDONG GAO
Simulated Acid Rain Leaching Characteristics of Acid Soil Amended with Bio-Briquette Combustion Ash 1451-1456

EFFECTS ON MATERIALS AND CULTURAL PROPERITIES

JOHAN TIDBLAD, VLADIMIR KUCERA, ALEXANDRE A. MIKHAILOV, JAN HENRIKSEN, KATERINA KREISLOVA, TIM YATES, BRUNO STÖCKLE and MANFRED SCHREINER
UN ECE ICP Materials: Dose-Response Functions on Dry and Wet Acid Deposition Effects after 8 Years of Exposure 1457-1462

M. KITASE, S. HATAKEYAMA, T. MIZOGUCHI and Y. MAEDA
Regional Characteristics of Copper Corrosion Components in East Asia 1463-1468

JOHAN TIDBLAD, VLADIMIR KUCERA and ALEXANDRE A. MIKHAILOV
Mapping of Acid Deposition Effects and Calculation of Corrosion Costs on Zinc in China 1469-1474

ELIN DAHLIN, PETER TORSSANDER, CARL -MAGNUS MÖRTH, HELÉNE STRANDH, GÖRAN ÅBERG, JAN F. HENRIKSEN, ODD ANDA and RUNO LÖFVENDAHL
Environmental Monitoring of Rock Carvings in Scandinavia..... 1475-1480

TSUTOMU KANAZU, TAKURO MATSUMURA, TATSUO NISHIUCHI and TAKESHI YAMAMOTO
Effect of Simulated Acid Rain on Deterioration of Concrete 1481-1486

Y. TSUJINO, Y.SATOH, N. KURAMOTO and Y. MAEDA
Effect of Acid Deposition on Urushi Lacquer in East Asia 1487-1492

ANALYTICAL METHODS AND MONITORING

KJETIL TØRSETH, WENCHE AAS and SVERRE SOLBERG
Trends in Airborne Sulphur and Nitrogen Compounds in Norway during 1985-1996 in Relation to Air Mass Origin 1493-1498

P. H. VIET, V. V. TUAN, P. M. HOAI, N. T.K. ANH and P. T. YEN
Chemical Composition and Acidity of Precipitation A Monitoring Program in North-Eastern Vietnam 1499-1504

MUNEHIRO WARASHINA, MASANOBU TANAKA, YOSHIO TSUJINO, TUGUO MIZOGUCHI, SIRO HATAKEYAMA and YASUAKI MAEDA
Atmospheric Concentrations of Sulfur Dioxide and Nitrogen Dioxide in China and Korea Measured by Using the Improved Passive Sampling Method 1505-1510

MOTONORI TAMAKI, TAKATOSHI HIRAKI, YOSHIHIRO NAKAGAWA, TOMIKI KOBAYASHI, MASAHIDE AIKAWA and MITSURU SHOGA
Study on Sampling Method of Rainfall, Throughfall, and Stemflow to Monitor the Effect of Acid Deposition on Forest Ecosystem 1511-1516

MASAHIDE AIKAWA, TAKATOSHI HIRAKI, MITSURU SHOGA and MOTONORI TAMAKI
Fog and Precipitation Chemistry at Mt. Rokko in Kobe, April 1997 - March 1998 1517-1522

YASUSHI NARITA, KEI SATOH, KENICHI HAYASHI and SHIGERU TANAKA
Development of Automatic Continuous Measurement System of Chemical Constituents in the Precipitation 1523-1528

ANNE -GUNN HJELLBREKKE and LEONOR TARRASON
Mapping of Concentrations in Europe Combining Measurements and Acid Deposition Models 1529-1534

YUKIO KOMAI, SATOSHI UMEMOTO and TAKANOBU INOUE
Influence of Acid Deposition on Inland Water Chemistry –A Case Study from Hyogo Prefecture, Japan – 1535-1540

C. D. EVANS, R. HARRIMAN, D. T. MONTEITH and A. JENKINS
Assessing the Suitability of Acid Neutralising Capacity as a Measure of Long-term Trends in Acidic Waters Based on Two Parallel Datasets 1541-1546

RASA GIRGZDIENE and ALOYZAS GIRGZDYS
Spatial and Temporal Variability in Ozone Concentration Level at Two Lithuanian Stations 1547-1552

AUDRONE MILUKAITE, ALDONA MIKELINSKIENE and BRONISLAVAS GIEDRAITIS
Characteristics of SO_2, NO_2, Soot and Benzo(a)pyrene Concentration Variation on the Eastern Coast of the Baltic Sea 1553-1558

KOICHI WATANABE, YUTAKA ISHIZAKA, YUKIYA MINAMI and KOJI YOSHIDA
Peroxide Concentrations in Fog Water at Mountainous Sites in Japan 1559-1564

OSAMU NAGAFUCHI, HITOSHI MUKAI and MINORU KOGA
Black Acidic Rime Ice in the Remote Island of Yakushima, a World Natural Heritage Area 1565-1570

SITI ASIATI, TUTI BUDIWATI and LELY QODRITA AVIA
Acid Deposition in Bandung, Indonesia 1571-1576

GÖRAN E. ÅBERG
Tracing Pollution and its Sources with Isotopes 1577-1582

YORIKO YOKOO and TAKANORI NAKANO
Sequential Leaching of Volcanic Soil to Determine Plant-Available Cations and the Provenance of Soil Minerals Using Sr Isotopes 1583-1588

KIN-ICHI TSUNODA, TOMONARI UMEMURA, KAZUMASA OHSHIMA, SHO-ICHI AIZAWA, ETSURO YOSHIMURA and KEN-ICHI SATAKE
Determination and Speciation of Aluminum in Environmental Samples by Cation Exchange High-Performance Liquid Chromatography with High Resolution ICP-MS Detection 1589-1594

WENCHE AAS and ARNE SEMB
Standardisation of Methods for Long-Term Monitoring 1595-1600

CHANG-JIN MA, MIKIO KASAHARA, SUSUMU TOHNO and TOMIHIRO KAMIYA
A New Approach for Characterization of Single Raindrops 1601-1606

LU-YEN CHEN, FU-TIEN JENG, YU-MEY HSU, SHIN-YUAN TSAI and UEI-RUEY PENG
Stability of Ionic Components in Precipitation Samples – a Case Study in Taipei 1607-1612

TSUNEHIKO OTOSHI, NORIO FUKUZAKI, HU LI, HIROSHI HOSHINO, HIROYUKI SASE, MASASHI SAITO and KATSUNORI SUZUKI
Quality Control and its Constraints during the Preparatory-Phase Activities of the Acid Deposition Monitoring Network in East Asia (EANET) 1613-1618

REGIONAL CASE STUDIES

N. KARVOSENOJA, P. HILLUKKALA, M. JOHANSSON and S. SYRI
Cost-Effective Abatement of Acidifying Emissions with Flue Gas Cleaning vs. Fuel Switching in Finland 1619-1624

DRIEJANA, D. W. RAPER, D. S. LEE, R. D. KINGDON and I. L. GEE
Wet Deposition to an Upland Area of England in1988 and 1999: Measurements and Modelling 1625-1630

DEXUAN WANG and WEI DENG
Atmospheric SO_2 Pollution and Acidity of Rain in Changchun China 1631-1634

T. LARSSEN, H. M. SEIP, G. R. CARMICHAEL and J. L. SCHNOOR
The Importance of Calcium Deposition in Assessing Impacts of Acid Deposition in China 1635-1640

MARTIN FORSIUS, SIRPA KLEEMOLA, JUSSI VUORENMAA and SANNA SYRI
Fluxes and Trends of Nitrogen and Sulphur Compounds at Integrated Monitoring Sites in Europe 1641-1648

YASUSHI NARITA, KEI SATOH, KEIICHI HAYASHI, TAKAMI IWASE, SHIGERU TANAKA, YUKIKO DOKIYA, MORIKAZU HOSOE and KAZUHIKO HAYASHI
Long Term Trend of Chemical Constituents in Tokyo Metropolitan Area in Japan 1649-1654

MASAKI ADACHI, KAZUHIKO HAYASHI and YUKIKO DOKIYA
Sea Ice Approach and Chemical Species in Precipitation at Abashiri, Japan 1655-1660

Y. MATSUURA, M. SANADA, M. TAKAHASHI, Y. SAKAI and N. TANAKA
Long-Term Monitoring Study on Rain, Throughfall, and Stemflow Chemistry in Evergreen Coniforous Forests in Hokkaido, Northern Japan 1661-1666

KAZUHIKO HAYASHI, YASUHITO IGARASHI, YUKITOMO TSUTSUMI and YUKIKO DOKIYA
Aerosol and Precipitation Chemistry During the Summer at the Summit of Mt. Fuji, Japan (3776 m a.s.l.) 1667-1672

NORIO FUKUZAKI, TSUYOSHI OHIZUMI and KAZUHIDE MATSUDA
Geographical and Temporal Variations of Chemical Constituents in Winter Precipitation Collected in the Areas along the Coast of the Sea of Japan 1673-1678

TSUYOSHI OHIZUMI, NAOKO TAKE, NOBORU MORIYAMA, OSAMU SUZUKI and MINORU KUSAKABE
Seasonal and Spatial Variations in the Chemical and Sulfur Isotopic Composition of Acid Deposition in Niigata Prefecture, Japan..... 1679-1684

UMESH C. KULSHRESTHA, MONIKA J. KULSHRESTHA, R. SEKAR, M. VAIRAMANI, AJIT K. SARKAR and DANESH C. PARASHAR
Investigation of Alkaline Nature of Rain Water in India 1685-1690

AHTI LEPISTÖ and SANNA SYRI
Modeling Effects of Changing Deposition and Forestry on Nitrogen Fluxes in a Northern River Basin 1691-1696

FRIDA EDBERG, HANS BORG and JAN -ERIK ÅSLUND
Episodic Events in Water Chemistry and Metals in Streams in Northern Sweden during Spring Flood 1697-1702

N. L. ROSE, E. SHILLAND, T. BERG , K. HANSELMANN, R. HARRIMAN, K. KOINIG, U. NICKUS, B. STEINER TRAD, E. STUCHLÍK, H. THIES and M. VENTURA
Relationships between Acid Ions and Carbonaceous Fly-Ash Particles in Deposition at European Mountain Lakes 1703-1708

H. FUSHIMI, T. KAWAMURA, H. IIDA, M. OCHIAI, T. NAKAJIMA and Y. AZUMA
Internal Distribution of Acid Materials within Snow Crystals..... 1709-1714

CECILIA ANDRÉN, PAUL ANDERSSON and ELISABETH FRÖBERG
Temporal Variations of Aluminium Fractions in Streams in the Delsbo Area, Central Sweden.....1715-1720

H. HANSEN, T. LARSSEN, H. M. SEIP and R. D. VOGT
Trace Metals in Forest Soils at Four Sites in Southern China 1721-1726

BARBARA WALNA, JERZY SIEPAK and STANISLAW DRZYMALA
Soil Degradation in the Wielkopolski National Park (Poland) as an Effect of Acid Rain Simulation 1727-1732

ZHAO DAWEI, T. LARSSEN, ZHANG DONGBAO, GAO SHIDONG, R. D. VOGT, H. M. SEIP and O. J. LUND
Acid Deposition and Acidification of Soil and Water in the Tie Shan Ping Area, Chongqing, China 1733-1738

M. JOHANSSON, R. SUUTARI, J. BAK, G. LÖVBLAD, M. POSCH, D. SIMPSON, J. -P. TUOVINEN and K. TØRSETH
The Importance of Nitrogen Oxides for the Exceedance of Critical Thresholds in the Nordic Countries 1739-1744

MAGNUS APPELBERG and TORBJÖRN SVENSON
Long-Term Ecological Effects of Liming - The ISELAW Programme..... 1745-1750

KERSTIN HOLMGREN
Biomass-Size Distribution of the Aquatic Community in Limed, Circumneutral and Acidified Reference Lakes 1751-1756

H. BORG, J. EK and K. HOLM
Influence of Acidification and Liming on the Distribution of Trace Elements in Surface Waters 1757-1762

FRIDA EDBERG, PAUL ANDERSSON, HANS BORG, CHRISTINA EKSTRÖM and EINAR HÖRNSTRÖM
Reacidification Effects on Water Chemistry and Plankton in a Limed Lake in Sweden 1763-1768

GUNNAR PERSSON and MAGNUS APPELBERG
Evidence of Lower Productivity in Long Term Limed Lakes as Compared to Unlimed Lakes of Similar pH..... 1769-1774

HIDEHISA KAWAMURA, NOBUAKI MATSUOKA, SHINJI TAWAKI and NORIYUKI MOMOSHIMA
Sulfur Isotope Variations in Atmospheric Sulfur Oxides, Particulate Matter and Deposits Collected at Kyushu Island, Japan 1775-1780

JUNLING AN, MEIYUAN HUANG, ZIFA WANG, XINLING ZHANG, HIROMASA UEDA and XINJIN CHENG
Numerical Regional Air Quality Forecast Tests Over the Mainland of China 1781-1786

VALDO LIBLIK and MARGUS PENSA
Specifics and Temporal Changes in Air Pollution in Areas Affected by Emissions from Oil Shale Industry, Estonia 1787-1792

TAKAHISA MAEDA, ZIFA WANG, MASAYASU HAYASHI and MEIYUAN HUANG
Long-Range Transport of Sulfur from Northeast Asia to Chengshantu, Shandong Peninsula: Measurement and Simulation 1793-1798

FRANK MURRAY, GORDON MCGRANAHAN and JOHAN C.I. KUYLENSTIERNA
Assessing Health Effects of Air Pollution in Developing Countries 1799-1804

PRABAL K. ROY and HIROSHI SAKUGAWA
Trends of Air Pollution and its Present Situation in Hiroshima Prefecture 1805-1810

SCIENCE & POLICY AND ENVIRONMENTAL EDUCATION

KEITH R. BULL
The Need for Education in Developing Acceptable Air Pollution Control Strategies 1811-1816

EDUARD DAME, and MIKE HOLLAND
Cost-Benefit Analysis and the Development of Acidification Policy in Europe 1817-1824

KENNETH E. WILKENING
Trans-Pacific Air Pollution: Scientific Evidence & Political Implications 1825-1830

SANNA. SYRI and NIKO KARVOSENOJA
Low-CO_2 Energy Pathways Versus Emission Control Policies in Acidification Reduction 1831-1836

WAKANA TAKAHASHI and JUSEN ASUKA
The Politics of Regional Cooperation on Acid Rain Control in East Asia 1837-1842

HAIPING LAI, HIROYUKI KAWASHIMA, JUNKO SHINDO and KEIJI OHGA
Stages in the History of China's Acid Rain Control Strategy in the Light of China-Japan Relations 1843-1848

YOSHIKAZU HASHIMOTO, YOSHIKA SEKINE, ZHI -MIN YANG and KANJI YOSHIOKA
Profound Survival Program of Forests in Japan Islands –a 40 Year Strategy for Environmental Conservation In Inland China – 1849-1854